B.R. 33003/246
December 1968

BRITISH RAILWAYS

B.R./SULZER/CROMPTON PARKINSON 2500 H.P., CLASS 45, DIESEL ELECTRIC LOCOMOTIVES FITTED WITH VACUUM-AIR BRAKES

PART 1

GENERAL DATA AND DESCRIPTION

LOCOMOTIVE DATA

Class	45
Type	1C-C1.
Weight in running order	135 tons 17 cwt.
Tractive effort:	
Maximum	55,000 lbs.
Continuous	30,000 lbs. at 25 m.p.h.
Wheel base	59ft. 8in.
Bogie wheel base	21ft. 6in.
Wheel diameter	3ft. 9in.
Bogie centres	32ft. 8in.
Width overall	9ft. $1\frac{9}{16}$in.
Length overall	67ft. 11in.
Height overall	12ft. $10\frac{1}{2}$in.
Minimum curve negotiable	5 chains.
MAXIMUM PERMITTED SPEED	90 m.p.h.

	Main	*Service*	*Total*
Fuel Tanks, Engine and Boiler	800 gallons	40 gallons	840 gallons
Lubricating Oil capacity:	*Engine sump and Piping*		190 gallons
Cooling Water tank:	*Engine and pipe work*	*Radiator*	*Total*
	300 gallons	46 gallons	346 gallons

Radiator	Serck type water coolers.
Boiler water tank	1,000 gallons
Brakes	Compressed air and handbrakes on the locomotive. Vacuum brake equipment giving proportional air braking on the locomotive.
Sanding	Compressed air operated.

POWER EQUIPMENT

12 Cylinder diesel engine	Sulzer type 12LDA28B 2,500 H.P. at 750 r.p.m.
Main generator	Crompton Parkinson CG 426 A1. Continuous rating at maximum engine speed, 2640 amps at 580 volts.
Traction motors (6)	Crompton Parkinson C172 A1.

AUXILIARY EQUIPMENT

Auxiliary generator, Crompton Parkinson CAG 252 A1 220 volts.
Traction motor blowers (2), motor driven.
Radiator fan (1), motor driven.
Air compressor (1), motor driven
Exhauster (1), motor driven
Combined oil, fuel transfer and coolant pump (1), motor driven.
Motor converter (1), 220 volts input, 110 volts output.
Battery, lead acid, 96 cells, 220 volts.
Carriage warmer Boiler ..... Stone-Vapour. OK4625.

CONTROLS AND EQUIPMENT IN EACH CAB

1. Mastery key (removable).
2. Reversing handle with OFF, REV, EO, FOR positions.
3. Power controller incorporating anti-slip brake button.
4. Vacuum brake valve.
5. Air brake valve.
6. Engine "start" lever.
7. Engine "stop" button.
8. Driver's safety device pedal incorporating "Vigilance" system (where fitted).
9. Sanding pedal.
10. Horn control—two tone (2).
11. Hand brake wheel.
12. Windscreen wipers (2) and control valves.
13. Windscreen washer controls (2).
14. Driver's safety device hold-over button on both sides, incorporating "Vigilance" system (where fitted).
15. Light switches for cab, engine room, marker or route indicator and tail lights.
16. Cab heater switches.
17. Instrument light switch.
18. Instrument light dimmer.
19. Main fire extinguisher release handle.
20. Fire alarm test button.
21. Portable fire extinguishers.
22. A.W.S. reset button.
23. A.W.S. switch.
24. Track circuit shorting clips.

CONTROLS OUTSIDE THE LOCOMOTIVE

1. Main lighting changeover switch.
2. Main fire extinguisher release handles (2).
3. Battery charge sockets (2 on "B" bank side only).
4. Shed light sockets (2).
5. Inspection lamp sockets (2).
6. Battery isolating switch "trip" handle.
7. Route indicator setting handles.

INSTRUMENTS AND GAUGES IN EACH CAB

1. Vacuum gauge (duplex).
2. Air brake gauge (Bogie 1 and 2).
3. Air pressure gauge (main reservoir).
4. Speedometer.
5. Main ammeter—marked with two bands—green and yellow.
6. "Engine stopped" indicator light (red).
7. "Wheel slip" indicator light (amber).
8. "Fault" indicator light (blue).
9. C.W.A. steam pressure gauge.
10. C.W.A alarm indicator light (white).
11. A.W.S. indicator.

INSTRUMENTS AND GAUGES IN ENGINE ROOM

1. Water pressure gauge.
2. Water temperature gauge.
3. Engine tachometer.
4. Lubricating oil temperature gauge.
5. Lubricating oil pressure gauge.
6. Regulating air pressure gauge.
7. Radiator tank water level gauge.
8. Charging air pressure gauge.
9. Control air pressure gauge.
10. Indicator lights:-
    (a) Engine cooling water temperature.
    (b) Traction motor blowers.
11. Battery charger ammeter.
12. Aux. Generator/Battery voltmeter.
13. See-tru type fuel gauges in fuel tanks and water tanks.
14. Radiator tank water level gauges.

CONTROLS IN ENGINE ROOM

1. Engine maintenance switch.
2. Engine local "start" button.
3. Control changeover switch—NORMAL (Converter)—EMERGENCY (Battery).
4. Passenger/goods switch (brake selector).
5. Voltmeter changeover switch—AUX. GEN.—BATTERY.
6. Exhauster switch ON—OFF—EMERGENCY.
7. Radiator fan switch—AUTO (thermostat)—EMERGENCY (direct).
8. Control circuit breaker PA.
9. Control circuit breaker PB.
10. Battery isolating switch.
11. Boiler isolating switch (in boiler room).

FUSES

Fuses mounted on control cubicle panel

1.	L.T. Voltmeter	5 amp	Type SRC or N 3003
2.	Cab Heaters (2)	30 amp	SRC or SRN 3010
3.	Hotplate	15 amp	SRC or SRN 3007
4.	Traction motor blower fuse	40 amp	SRC 3010
5.	Main generator field	30 amp	SRC or SRN 3010
6.	Boiler main fuse	30 amp	SRC 3010
7.	Pump set motor	60 amp	Aeroflex F01
8.	Compressor motors (1)	50 amp	Aeroflex S5763/SX
9.	Radiator fan motor	250 amp	TKF 250
10.	Motor convertor	30 amp	SRC or SRN 3010
11.	Exhauster motor	60 amp	Aeroflex F01

Fuses mounted in lighting panel

1.	Instrument lights	5 amp	SRC or SRN 3003
2.	Cab and nose lights (3)	5 amp	SRC or SRN 3003
3.	Engine room, boiler compartment and cubicle lights (3)	15 amp	SRC or SRN 3007
4.	Marker Route indicator and tail lights	5 amp	SRC or SRN 3003
5.	Control Emergency	30 amp	SRC or SRN 3010

Fuse in Battery Isolating switch box

— one 500 amp and one spare TTM 500

Spare fuses in cubicle fuse box

1 30 amp	SRC 3010 Boiler spare
1 60 amp	FOS 60
1 60 amp	TCP 60
2 30 amp	SRC or SRN 3010
1 15 amp	SRC or SRN 3007
2 2 amp	1R18 S/2A
1 5 amp	SRC or N 3003

CHANGING FUSES

In the event of a fuse failure, one of the spares carried may be used, but care must be taken that it is one of the same capacity as the one which is defective. The fuses can be identified by their marking. Test all suspected fuses and replacements on the fuse tester provided. The fuse tester is situated in the lighting fuse box.

The following procedure should be used when changing fuses:-

(1) Stop the engine, then place battery isolating switch to OFF.

(2) Take out the suspected fuse.

(3) Hold fuse by centre portion, place it across tester contacts which are alive. If correct the lamp will light.

(4) Place the battery isolating switch to ON after replacing the fuse.

NOTE: The battery isolating switch MUST always be placed to OFF before removing or replacing a fuse.

Colour Identification of Pipe Lines

Line	*Colour*	*Symbol*
Air, compressed	White	A.C.
Vacuum	White	A.V.
Air ventilation inlet	White	A.I.
Air ventilation exhaust	White	A.E.
Drainage	Black	
Electrical	Orange	
Fire installations	Signal red	
Oil, Diesel fuel	Light brown	O.D.
Oil, lubricating	Salmon pink	
Steam	Aluminium	
Water, engine cooling	French blue	
Water, C.W.A. feed	Grass green	

GENERAL DESCRIPTION

Power

The BR/Sulzer/Crompton Parkinson 2,500 HP locomotives are powered by a twin bank, twin crankshaft engine with 6 cylinders in each bank. 2 crankshafts are geared together through the medium of a common output shaft pinion, which in turn drives the main generator and auxiliary generator. The deployment of the power generated by these two generators can be seen from the chart on Page 7.

Cooling System

The coolant is drawn from the radiator settling tanks by the coolant pump section of the triple pump and is then forced under pressure to the engine heat exchanger, engine, turbo-charger and inter-coolers. After leaving the engine system the coolant passes through an auxiliary tank and then to a thermostatic valve. The thermostatic valve diverts the coolant from the radiators when it is cold, until it has reached 169°-175°F, after which it passes through the radiator panels for normal cooling. An electrically driven fan draws air through the radiator panels. A pressure gauge indicates the coolant pressure and a pressure switch stops the engine if the coolant pressure drops to a dangerously low level. A thermometer indicates the coolant temperature when it leaves the engine.

Fuel System

The fuel is drawn from the main tank through a strainer by the fuel pump section of the triple pump and is then forced under pressure through fine filters to the engine fuel injection pumps. A relief valve allows the excess fuel to pass to the service tank and when this is full, it flows back to the main tank. The train heating boiler takes the supply of fuel by gravity from the service tank.

Lubricating Oil System

The oil priming pump section of the triple pump draws oil through a strainer and forces it to the engine main bearings, big end bearings, pistons and engine governor, before the engine is started. When the engine is started an engine driven oil pump draws oil through the strainer and forces a proportion of it through the heat exchanger to

the fine filters. From the fine filters the oil passes to the engine, engine governor and turbo charger, and finally back to the engine sump. A pressure gauge is provided to show the oil pressure and the pressure switch is provided to stop the engine if the lubricating oil pressure drops to a dangerously low level. A thermometer indicates the lubricating oil temperature when it leaves the exchanger.

Brake System

The locomotive is equipped with air brakes, which can be applied directly by a straight air brake valve, when running light, or by the vacuum brake valve which will apply the train brakes and give a proportionate air brake application on the locomotive. A vacuum governor will cut off the power to the traction motors if the vacuum falls to 12½ in. Hg. or less.

Low tension electrical system

The auxiliary generator under the control of an automatic voltage regulator provides low tension current at 220 volts for the purpose of charging the battery and supplying power for the auxiliary machines, boiler, cab heaters, cooker and lighting. A motor generator (rotary converter) reduces the 220 volts to 110 volts for working the control system. See the chart on Page 7 for the arrangement of the auxiliary generator supplies.

Train Heating Boiler

These locomotives are fitted with a Stone Vapor OK 4625 boiler with a maximum output of 2750 lbs. of steam per hour at 55 p.s.i. Operating instructions are given in B.R.33066/1 "Operating Instructions and Fault Finding Data for Clayton, Stone-Vapor and Spanner Train Heating Boilers."

FIRE PROTECTION

The locomotive is fitted with two sets of fire fighting equipment:-

1. Portable extinguishers—One BCF 12lb. portable extinguisher in each driving cab (these extinguishers are gradually replacing the existing CO_2 and CTC portable extinguishers).
2. Fixed extinguishers—three CO_2 extinguishers in the engine room.

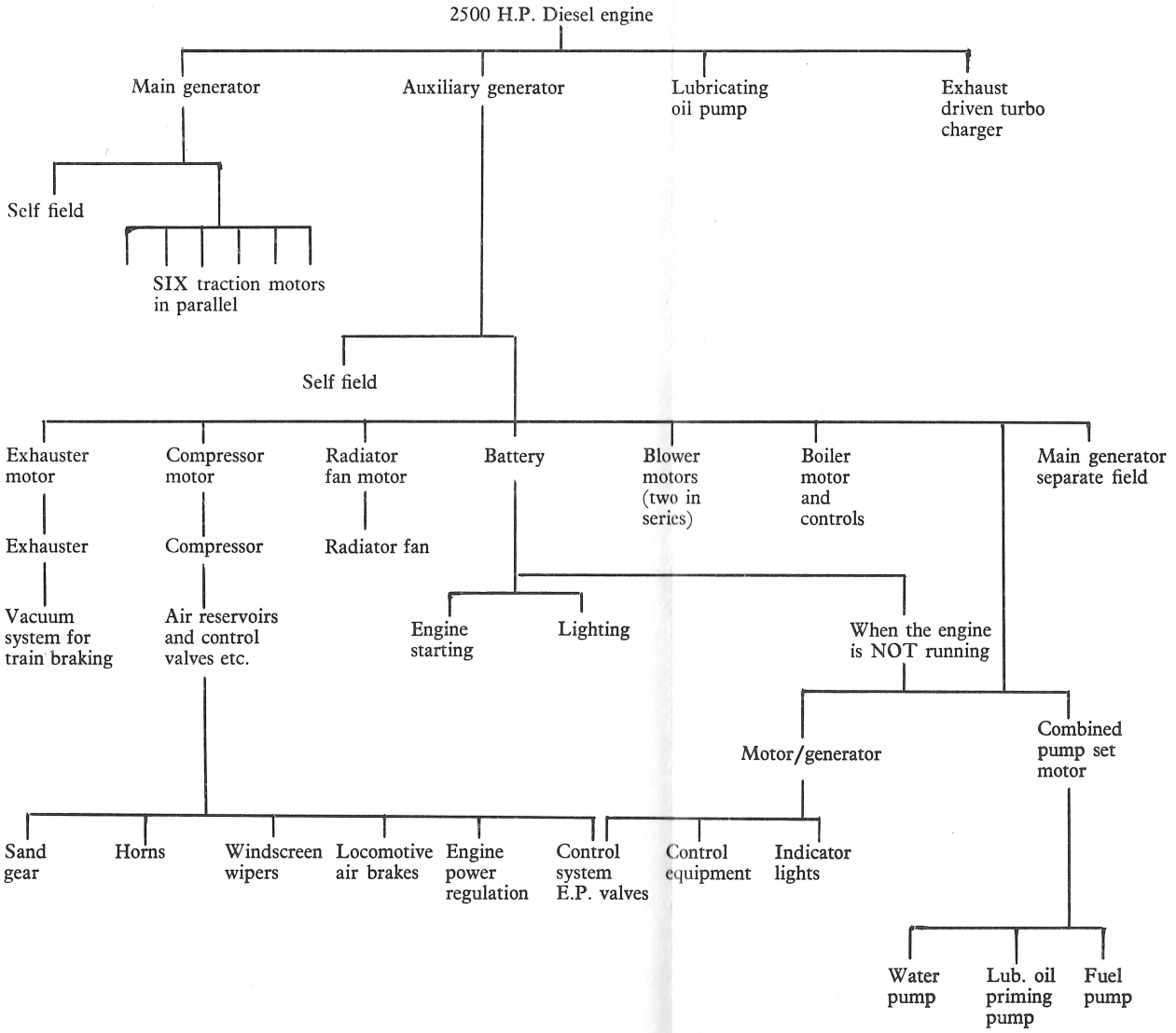
If a fire breaks out in the engine room or boiler room, one or more of the fire detectors will operate the alarm bell in each cab.

If the fire bells ring, investigate the cause. Should a fire occur proceed in accordance with the instructions on Page 8 of "Driver's Instructions for the Operation of Diesel Train Locomotives, Diesel Shunting Locomotives and Diesel Multiple Unit Trains with Electric, Hydraulic and Mechanical Transmissions" (B.R.33003/6 Revised April 1968).

Before operating the main extinguishers, LOOK FOR THE FIRE TO ENSURE THAT A FALSE ALARM HAS NOT BEEN GIVEN by a fault in the alarm system.

POWER AND TRANSMISSION SYSTEM

The power of the Diesel engine is utilised as follows:-



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PART 2

DRIVING INSTRUCTIONS INCLUDING STANDARD PREPARATION AND DISPOSAL INSTRUCTIONS

STANDARD PREPARATION DUTIES

When commencing duty each Driver must have in his possession and retain throughout his turn:-

(a) A master key.

(b) An A.W.S. change end key (where necessary).

Driving from No. 1 Cab

1. **At the locomotive**

   Open No. 1 cab door, enter driving cab and store personal belongings and equipment.

2. **External examination**

   Check that all air pipe cocks are closed.

   Set the headcodes, where controlled externally, as necessary.

   Ensure that no depot pipes or electric cables are attached and that the lighting changeover switch is in the NORMAL position.

   Check that all air pipe cocks are closed at No. 2 end.

   Return to the driving cab along the other side of the locomotive.

3. **In the driving cab**

   Check that the handbrake is ON.

   Place the air brake handle to RELEASE and the vacuum brake handle to the NEUTRAL or RUNNING position.

   Check that the detonator case is intact and hand fire extinguishers are **in position.**

   Check that the track circuit shorting bonds are in position.

   Check the fuel and water contents gauges.

   Take the master key and carriage key.

4. **Proceed to the non-driving cab**

   En route check the radiator water level in the gauge glass.

   Check that the safety pins are removed from the fire bottles.

   Close the battery isolating switch.

   Check that:-

   (1) The control changeover switch is at NORMAL.

   (2) The P.A. and P.B. circuit breakers are in the ON position.

   (3) The brake selector switch is in a PASSENGER position.

5. **In the non-driving cab**

   Place the air brake handle to RELEASE and vacuum brake handle to NEUTRAL or RUNNING position.

   Insert the master key and start the engine. (See page 2).

   Check that the detonator case is intact and hand fire extinguishers are **in position.**

   Check that the track circuit shorting bonds are in position.

   Release the handbrake.

Check that the A.W.S. is not in use and that the red handle is sealed in the up position.

Close all doors and windows.

Remove the master key, leaving engine running.

7. **Proceed to the driving cab.**

   En route make a cursory examination of the engine and generator compartments for obvious defects and close all internal doors.

   Enter the driving cab.

   Close the A.W.S. switch and check that the red handle is sealed in the up position.

   Insert the master key and move the reversing handle to the E.O. position.

   Check the air pressure and test the brakes.

   Move the reversing handle to FORWARD, release the handbrake and at the same time check the operation of the Driver's safety device.

   Sound the warning horn.

STARTING THE ENGINE

1. Check that the handbrake is ON in the cab from which starting is to be initiated.
2. Close the battery switch.
3. Place the air brake handle in the RELEASE position.
4. Inset the master key into the controller and turn it to the unlocked position.
5. Place the reversing handle in the E.O. position and leave it for TWO minutes. This will run the combined pump set and air compressor.
6. Move the engine starting lever and hold it firmly in the START position until the engine fires and the red "Engine Stopped" light goes dim.

   A local "Start" button is provided on the control cubicle and can be used as an alternative.

   NOTE : Under no circumstances must the "Start" lever or button be kept depressed if the engine fails to turn over within 15 seconds. If the engine turns but does not fire after approximately 30 seconds and no cause is apparent to the driver, the matter must be reported.

   With the engine running and the reversing handle in the E.O. position no power circuits are made, but the auxiliary generator provides power for the auxiliary machines and battery charging.

TO MOVE THE LOCOMOTIVE

1. Before attempting to move the locomotive ensure that the main reservoir air pressure is at least 85 p.s.i. and that 21in. Hg is being maintained by the exhauster.

2. Place the brake selector (Passenger/Goods) switch into the appropriate position. When running "light locomotive" the switch MUST be placed in the PASSENGER position.

3. Release the handbrake.

4. Check that the A.W.S. switch is closed.

5. Place a foot on the Driver's safety device pedal and depress it, then move the reversing handle into FORWARD or REVERSE for the desired direction of travel.

   THE REVERSING HANDLE MUST NOT BE MOVED FROM THE FULL FORWARD OR FROM THE FULL REVERSE POSITION WHEN THE LOCOMOTIVE IS IN MOTION.

6. To move the locomotive, release the brakes. Move the power controller to ON and then to the $\frac{1}{4}$ power position. If the train does not move, gradually advance the controller to the $\frac{1}{2}$ power setting. If the train still does not move investigate the cause. Do not allow the train to remain stationary for more than 15 seconds with the ammeter reading in the yellow sector. After the train has moved, increase the power to the maximum until the required speed is obtained, then adjust the controller position as necessary.

   The maximum current of 4,050 amps may be used for acceleration. Current in excess of 4,000 amps should not be used for more than 2 minutes in any hour. A continuous traction current of up to 2,600 amps is permissible, but periods of running with current in excess of this value must be limited.

   If wheelslip occurs, as indicated by the amber light or speedometer, return the power controller to the ON position, then increase the power again more gradually. If slipping persists, move the power controller back to the OFF position, press the anti-slip button and increase the power again. Release the anti-slip button when slipping has been brought under control. Do not allow the ammeter reading to remain in the yellow sector with the anti-slip button depressed. If slipping still persists, return the power controller to the ON position, apply sand when the amber light is extinguished and gradually increase the power again.

   NOTE : If the straight air brake is applied to hold the locomotive on a gradient, it must be released simultaneously with the movement of the power controller.

WHILST RUNNING

Engine Speeds

The diesel engine runs at approximately 325/365 r.p.m. at idling increasing to 750 r.p.m. at maximum power.

By moving the main power handle between OFF and FULL the controlled power position of the engine governor is progressively opened or closed according to direction of controller movement, and the diesel engine speed will be held steady so long as the power handle setting remains unchanged.

INDICATIONS

Indicator lights in cab

Fault	(Blue)	normally dim
Engine stopped	(Red)	bright on fault
Wheel slip	(Amber)	
CWA Generator	(White)	

Indicator light failure

If an indicator light is extinguished and no apparent cause is found, this may be due to a bulb failure and the indicators in the other driving cab should be checked. If these are functioning normally the locomotive can proceed.

Amber Light—Wheel Slip

Should wheel slip occur, indication will be given by the wheel slip indicator amber light. Proceed as shown on page 24 in Part 3 " Fault Finding Data and Charts."

Red Light—Engine Stopped

The engine is shut down automatically in the case of the following defects and the red light becomes bright:-

(a) Low oil pressure

(b) Low water pressure

(c) Engine over-speed device tripped

NOTE : Should the main generator field fuse fail, power will be lost and the **Red fault light** will become bright but the diesel engine will not shut down—check fuse and renew if necessary.

Blue Light—Fault

The blue light becomes bright in the case of the following faults:-

(a) High water temperature

(b) Blower motor failure

In addition to the above indications, the blue light will become bright when the power controller is in a power position when the following faults occur:-

(c) Loss of vacuum below 12½in. Hg

(d) Loss of air pressure below 75 p.s.i.

(e) A power earth fault.

See also page 22 in Part 3 " Fault Finding Data and Charts."

White Light—Boiler Alarm

The boiler indicator light becoming bright indicates a fault in the equipment.

When the light is out, the following conditions are indicated:-

(a) Boiler switch OFF

(b) Indicator circuit fault

(c) Lamp failure
(d) Boiler fuse ruptured.

NOTE : In the event of a fault developing the red light adjacent to the boiler main switch will also become bright.

Brake Application

The brakes, locomotive and train, are applied by operating the driver's vacuum brake valve. A vacuum brake application can only be made when the exhauster is running. The air brake valve does NOT apply the vacuum brake. The brakes must not be applied whilst the power controller is in a POWER position, except when buffering up to couple to a train or another locomotive, see page 19, B.R.33003/6, April, 1968. The vacuum governor will cut off power to the traction motors whenever the vacuum falls below 12½in. Hg. Power cannot be restored until a vacuum of 15in. Hg has been created.

Driver's safety device

If the Driver's safety device pedal is released when the power controller is in a power position a brake application is made after 5-7 seconds delay and the power is cut off. The Diesel engine continues to run at its idling speed. When a D.S.D. application occurs, the following action must be taken to regain control:-

(a) Return the power controller handle to OFF.
(b) Depress the D.S.D. pedal.
(c) Allow time for the brakes to be fully released.
(d) Re-apply power, taking extreme care if a loose coupled train is being worked.

If the Driver's safety device fails it must be cut out by the isolating cock provided for the purpose, and the Driver must, if possible, work the train into the first telephone, signal box or station, there report the position and await further instructions.

NOTE : Locomotives of this class are being modified to incorporate the "vigilance" system of Driver's safety device. Vigilance systems have a three position pedal which functions as follows:-

(1) "Released" position i.e. with no pressure applied.
(2) "Balanced" or "Mid" position.
(3) "Reset" position.

A timing device in a vigilance system operates an audible warning after the pedal has been maintained in the "Mid" position for a certain period; usually in the order of one minute. The pedal must then be depressed to the "Reset" position and returned to the "Mid" position. Failure to do this will result in a brake application, 5 to 7 seconds after the sounding of the warning. Pressing either the D.S.D. holdover button to the full "RESET" position or the A.W.S. reset button when the horn is sounding will also reset the vigilance device.

TO STOP THE LOCOMOTIVE

1. Return the power controller to the OFF position.
2. Apply the brakes with a SERVICE application.

In emergencies the power handle should be returned immediately to the OFF position and the brakes may be applied with an EMERGENCY application.

TO REVERSE THE LOCOMOTIVE

1. Return the power controller to the OFF position.
2. Bring the locomotive to a stand.
   DO NOT ATTEMPT TO REVERSE WHEN THE LOCOMOTIVE IS MOVING.
3. Move the reversing handle to the required direction.
4. Release the brakes, then operate the power controller as required.

CHANGING ENDS

When changing from one end of the locomotive to the other:-

1. Apply the brakes by making an emergency brake application with the vacuum brake valve.
2. Place the reversing handle in the OFF position to stop the exhauster.
3. Remove the master key.
4. Open the A.W.S. change end switch.
5. Place the vacuum brake valve in the RUNNING position.
6. Ensure that the air brake valve is in the RELEASE position.
7. Check that the locomotive air brakes are applied.
8. Check that the handbrake is released.
9. Proceed to the other cab.
10. Place the air brake handle in the ON position and close the A.W.S. change end switch.
11. Move the locomotive as previously instructed.

TO STOP THE ENGINE

1. Ensure that the power controller is in the OFF position and that the locomotive is stationary.
2. Move the reversing handle to the OFF position.
3. Press the stop button.
4. Apply the handbrake.

NOTES :

(a) If the engine stops when on full load for any reason EXCEPTING THE CASE OF FIRES, bring the train to a stand and then place the reversing handle in the E.O. position, leaving it there for two minutes. This will enable the combined pump set to run and reduce the engine temperature evenly. The reversing handle should then be placed in the OFF position and the reason for the engine stopping should be investigated. When the fault has been corrected the engine may be restarted in the normal way.

(b) In the event of FIRE the train should be brought to a stand as soon as possible and the reversing handle must be immediately placed in the OFF position. See page 8, B.R.33003/6. April, 1968.

STANDARD DISPOSAL DUTIES

1. In the Driving Cab **move the reversing handle to the "E.O." position,** apply the handbrake and stop the engine.
2. Release the air brake, place the vacuum brake to the RUNNING position.
3. Move the reversing handle to OFF and remove the master key. Close the cab windows.
4. Proceed to the non-driving cab.
5. In the non-driving cab: apply the handbrake and close all windows and doors.
6. Outside the locomotive. Open the battery isolating switch, place the lighting changeover switch to SHED and collect personal gear from the cab. Close the door.

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B.R./SULZER/CROMPTON PARKINSON 2500 H.P., CLASS 45, DIESEL ELECTRIC LOCOMOTIVES FITTED WITH VACUUM - AIR BRAKES

PART 3

FAULT FINDING DATA AND CHARTS

NOTES FOR THE GUIDANCE OF DRIVERS WHEN A FAULT OCCURS

1. If a locomotive shows only a slight reduction of power no immediate action is necessary. A check on the equipment should be made at the next stopping point. If no obvious defects can be seen the journey may be completed.

2. If a severe reduction of power occurs an investigation should be made within five minutes, at the most convenient stopping place. An immediate stop may be necessary, if the shortage of power is accompanied by excessive vibration, noise or smoke from any part of the locomotive. If a period of coasting will allow the train to proceed to a booked stopping point, there is no need to bring it to a stand within five minutes, provided that no serious defects are evident.

3. A shortage of power will probably be accompanied by a warning light becoming bright or an abnormal instrument reading. All indications should be noted before the train is brought to a stand. GREAT CARE MUST BE TAKEN TO ENSURE THAT NO SIGNAL ASPECTS OR LINESIDE WARNING BOARDS ETC. ARE MISSED WHENEVER INDICATORS OR INSTRUMENTS ARE BEING CHECKED.

4. If a complete loss of power occurs, but the exhausters are still running, an attempt should be made to coast and bring the train to a stand under the protection of the next fixed signal.

5. In the event of a Diesel engine shutting down in service an application of the brakes will occur and the train should therefore be stopped, if possible, at the next fixed signal.

   When a train has been brought to a stand as a result of a locomotive failure and the necessary Rules have been carried out, refer to the chart with a heading applicable to the indication or defect. This will show the various possible causes of the trouble and indicate the action to be taken.

   In some instances the possibilities may be numerous and the simpler defects should be checked before the more difficult ones. When a cause for a defect can be definitely established and it is known that it can be corrected, inform the nearest signalman, station official or the Traffic Control stating how long it will be before the trouble can be overcome. Return to the locomotive and take the necessary action. When the defect has had attention, start the engine and make a test to ensure that traction power can be obtained and that the auxiliaries function normally. The train may then be worked forward.

   If any doubt exists as to the possibility of overcoming the fault, a fresh locomotive must be requested immediately. If the defective locomotive can only work forward on reduced power arrangements must be made for a fresh locomotive to be provided at some point on the journey.

   At the end of the journey the defect must be reported, and the full facts must be entered in the Repair Book. This will greatly assist the maintenance staff at the depot to where the locomotive is taken in identifying the cause of the defect.

   The following chart indicates the readings normally given by all the instruments and indicates the action to be taken if incorrect readings are given when the engine is running.

FAULT FINDING INSTRUCTIONS

GENERAL

In the following text the word "engine" refers to the Diesel power unit within the locomotive. The word "engine" is not to be used when referring to the locomotive as a whole. This is very important when reporting defects.

WARNINGS

Warnings of various defects are given by three coloured lights on the driving desk. These normally glow dimly. When a fault occurs they become bright although they will become extinguished if the P.B. circuit breaker trips or when extensive defects occur. If one indicator light becomes extinguished the corresponding indicator in the rear cab should be checked and if this glows dimly the locomotive may proceed.

The indications are as follows:-

(a) Red light bright—Diesel engine stopped.

(b) Amber light bright—Wheel slip. If amber light indications are given over 45 m.p.h. a fault in a traction motor or its associated circuitry may be the cause.

(c) Blue light bright—This indicates a fault or faults which may be individually indicated in the engine room.

(d) In addition to the indications on the driving desk a white indicator is provided on the second man's desk. This is normally extinguished, but glows dimly when the train heating boiler is working. A defect in the boiler will cause the indicator to glow brightly.

Two indicator lights are provided in the control cabinet. These normally glow dimly, but become bright for the following reasons:-

(a) WATER TEMPERATURE LIGHT. This light becomes bright if the engine coolant temperature rises to 185°F.

(b) TRACTION MOTOR BLOWERS. This light becomes bright if the traction motor blowers stop running for any reason.

A fault indication by one of these lights will cause the cab fault light to become brightly illuminated.

A flag is provided on the earth fault relay. This may be seen by looking through the glass window in the left hand door of the power equipment cubicle. The flag normally indicates SET. If a power earth fault occurs the flag will indicate TRIP. There will then be a loss of traction power and the cab fault light will become brightly illuminated.

EFFECT OF THE P.A. CIRCUIT BREAKER TRIPPING OR TRIPPED

(a) The engine will not start.

(b) When standing with the Diesel engine running:-
The engine will stop.

(c) When working a train:-
The engine will stop and the brakes will be fully applied by the driver's safety device. The red "ENGINE STOPPED" light will become brightly illuminated.

The following circuits take their supply from the motor/generator set through the P.A. circuit breaker when the engine control switch is at NORMAL control:-

(1)	The water pump operating coils	WPC
(2)	The starting contactor operating coils	S1 & S2
(3)	The engine governor solenoid	ERS
(4)	The engine stop relay	STP
(5)	The driver's safety device	DMV
(6)	The power control relay	PC
(7)	The reversing contactor operating coils	
(8)	Traction motor field diversion	
(9)	Train wire II relay	TWR II
(10)	Main generator self timing contactor	Z1-4
(11)	Engine speed valve	
(12)	Motor contactor	M

EFFECT OF THE P.B. CIRCUIT BREAKER TRIPPING OR TRIPPED

(1) The fire alarm circuit will be inoperative.
(2) The cab and engine room indicator lights will be extinguished.
(3) The brake selector switch will be inoperative and will give the same function as for GOODS in both positions.
(4) The exhauster will not run with the switch in the "ON" position, but will run with the switch in the "EMERGENCY" position.
(5) The exhauster will not speed up in the "RELEASE" position of the driver's brake valve.
(6) The sanders will not operate.
(7) The anti-slip button will be inoperative.
(8) The compressor will not run but can be re-started by placing the exhauster switch in the EMERGENCY position.
(9) The radiator fan will not run with the radiator fan switch at NORMAL but will run with the switch in the EMERGENCY position.

If the P.B. circuit breaker trips when working a train the vacuum will be slowly destroyed due to the exhauster stopping and the indicator lights will be extinguished. Air pressure will be lost due to the compressor stopping. The loss of air pressure will be more rapid if the boiler is operating. The train should, if possible, be run to the protection of fixed signals. When the train has stopped, the P.B. circuit breaker should be reset. If the circuit breaker will hold in, the train may proceed. If it will not, proceed as follows:-

(a) Turn the exhauster switch from ON to EMERGENCY.
(b) Turn the radiator fan switch from NORMAL to EMERGENCY.

EFFECT OF RUPTURING OF THE FUSES IN THE CONTROL AND AUXILIARY SYSTEMS OF THE LOCOMOTIVE

BATTERY FUSE. 500 amps. The battery will not be charged. The engine will not start.

MOTOR CONVERTER FUSE. 30 amps. The motor converter will not run. The engine will not start. When running the engine will

stop, the indicator lights will be extinguished and a full application of the brakes will be made by the Driver's safety device. If the replacement fuse ruptures, the locomotive may be worked to its destination by turning the control changeover switch to EMERGENCY and then proceeding in the normal way. The locomotive must be failed at its destination and the defect must be reported in the Repair Book.

COMPRESSOR FUSE. 60 amps. The compressor will not run and the locomotive will lose power when the air pressure drops to 75 p.s.i.

WATER PUMP FUSE. 60 amps. The triple pump will stop and the engine will shut down.

EXHAUSTER FUSE. 60 amps. The exhauster will stop and the brakes will be gradually applied due to loss of vacuum.

RADIATOR FAN FUSE. 250 amps. The radiator fan will stop and the engine will become overheated.

BLOWERS FUSE. 40 amps. The traction motor blowers will stop and the blue FAULT light will become bright.

HOT PLATE FUSE. 15 amps. The hotplate will not heat up.

No. 1 CAB HEATER FUSE. 30 amps. The No. 1 cab heater will not function.

No. 2 CAB HEATER FUSE. 30 amps. The No. 2 cab heater will not function.

GENERATOR FIELD FUSE. 30 amps. Traction power will be lost although it may be temporarily retained at high speeds. The red ENGINE STOPPED light will become bright, but the engine will not stop.

LOW TENSION VOLTMETER FUSE. 5 amps. There will be no reading on the low tension voltmeter.

EMERGENCY CONTROL FUSE. 30 amps. The emergency changeover switch will be ineffective in the event of a motor converter failure.

FUEL SUPPLY TO THE DIESEL ENGINE

Shortage of fuel to the engine is indicated by misfiring, uneven running or complete shutdown.

Engine failure due to fuel shortage is caused by:-

(a) Shortage of fuel in the main tanks. This can be verified by checking the See-Tru gauges.

(b) Failure of the fuel transfer pump.

In the event of a failure of the main fuel transfer pump, the locomotive can be operated by gravity fuel feed from the emergency service tank containing 40 gallons of fuel, which should be adequate for 30 to 40 minutes running.

To operate with the emergency service tank in use the following procedure should be carried out:-

(a) Open the gravity feed supply valve located immediately below the tank.

(b) Close the pressure feed supply valve adjacent to valve (a) above.

(c) Open the fuel fine filter by-pass valve by means of the special key provided.

This will allow the gravity feed to pass by the fuel fine filter to the engine fuel bus line.

DRIVING COMPARTMENT INSTRUMENT READINGS WHEN THE ENGINE HAS BEEN RUNNING FOR AT LEAST FIVE MINUTES

Instrument	Reading		Action to be taken if incorrect readings are given
	Loco. standing	Loco. moving	
Main reservoir air pressure gauge	85-100 p.s.i.	85-100 p.s.i.	Report any variations below 85 p.s.i. or above 100 p.s.i. If pressure is lost see page 4.
Brake cylinder pressure gauge	0-70 p.s.i.	0 p.s.i.	Any variations from the maximum figure with the vacuum gauge reading zero must be reported in the Repair Book.
Vacuum gauge	0-21in. Hg	0	Any variations from 21in. Hg with the brake fully released must be reported in the Repair Book.
Speedometer	0	0-90 m.p.h.	The maximum speed of 90 m.p.h. must not be exceeded. Defective speedometers must be reported, in the Repair Book.
Driving ammeter	0	0-4050 amps	This instrument is divided into yellow and green segments. The locomotive should not be worked with the ammeter needle in the yellow segment for more than one hour. Rapid fluctuations of the readings when the controller is not being moved must be reported in the Repair Book.

ENGINE ROOM INSTRUMENT READINGS WHEN THE ENGINE HAS BEEN RUNNING FOR AT LEAST FIVE MINUTES

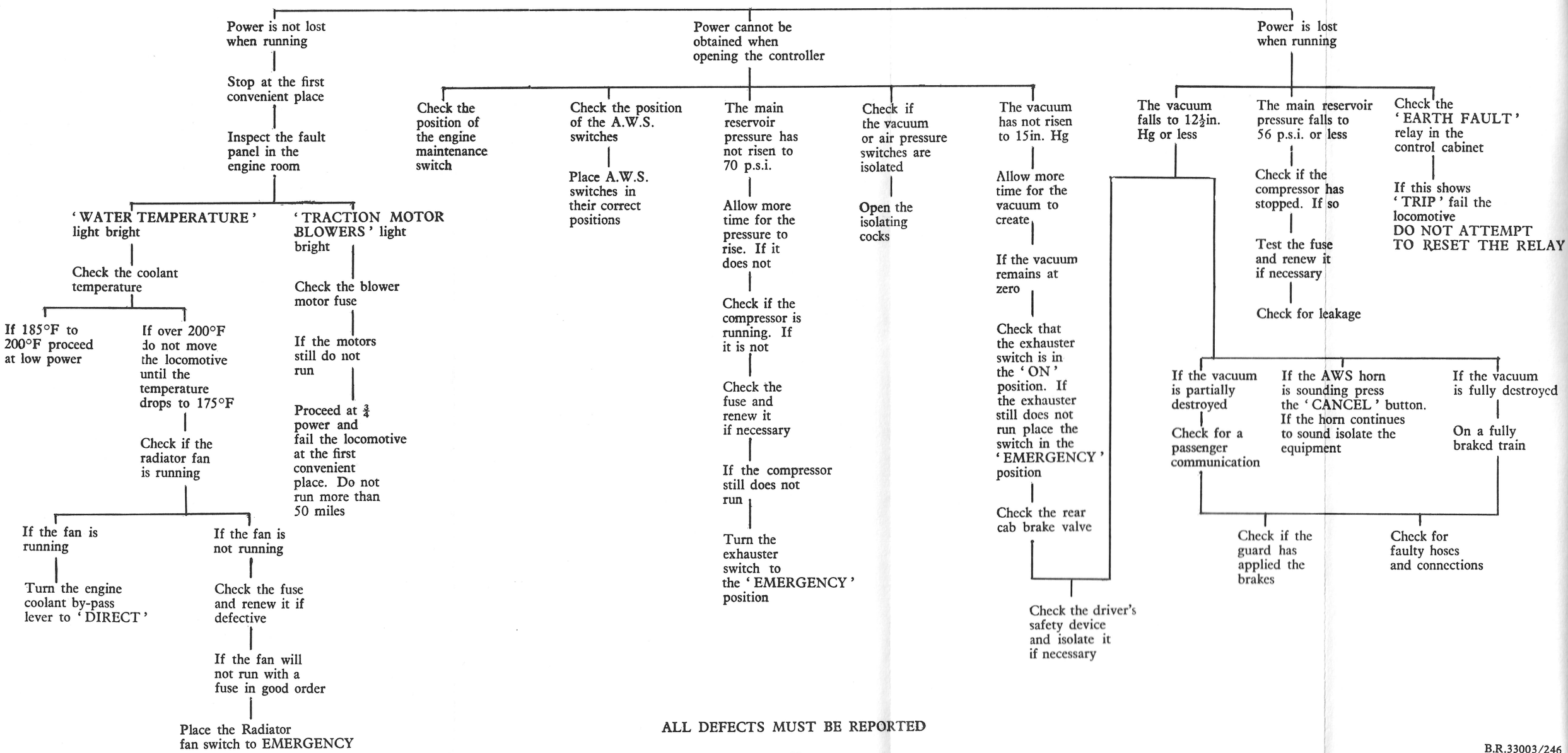
Instrument	Reading		Action to be taken if incorrect readings are given
	Loco. standing	Loco. moving	
Battery charging ammeter	Variable charge according to the battery condition	Variable charge according to the battery condition	This instrument will give a higher reading immediately after the engine has been started. If a discharge is indicated the locomotive must be failed at the first opportunity.
Battery voltmeter	218-220 volts	218-220 volts	Report any variations above or below these limits when the instrument is switched to AUXILIARY GENERATOR.
Control air pressure gauge	70 p.s.i.	70 p.s.i.	Report any variations in the Repair Book.
Regulating air pressure gauge	0	0-50 p.s.i.	Proceed but report if the maximum varies by more than 5 p.s.i. either way.
Water pressure gauge	10-17 p.s.i.	10-17 p.s.i.	If the pressure remains steady above 17 p.s.i. the locomotive should work forward to its destination and the defect must be reported in the Repair Book. If the pressure fluctuates rapidly above 17 p.s.i. with the engine running, the locomotive should be failed at the earliest opportunity, because this may indicate a defect in a cylinder liner.

ENGINE ROOM INSTRUMENT READINGS WHEN THE ENGINE HAS BEEN RUNNING FOR AT LEAST FIVE MINUTES

Instrument	Reading		Action to be taken if incorrect readings are given
	Loco. standing	Loco. moving	
Lubricating oil pressure gauge	20-50 p.s.i.	20-50 p.s.i.	If the oil pressure falls to 12 p.s.i. the engine will shut down. All cases of oil pressure above or below the specified readings must be reported in the Repair Book.
Water temperature gauge	Variable	160°-180°F	A blue FAULT light warning is given if the temperature exceeds 185°F. The locomotive must not be moved if the temperature exceeds 200°F. until it falls again to 175°F. (See page 10).
Lubricating oil temperature gauge	Similar to coolant	Similar to coolant	The locomotive must be failed if the temperature is seen to exceed 200°F. The engine must be shut down immediately if excessive knock is heard.

THE BLUE FAULT LIGHT BECOMES BRIGHT

PROBABLE CAUSE


Power is not lost when running
Stop at the first convenient place
Inspect the fault panel in the engine room
'WATER TEMPERATURE' light bright
Check the coolant temperature
If 185°F to 200°F proceed at low power
If over 200°F do not move the locomotive until the temperature drops to 175°F
Check if the radiator fan is running
If the fan is running
Turn the engine coolant by-pass lever to 'DIRECT'
If the fan is not running
Check the fuse and renew it if defective
If the fan will not run with a fuse in good order
Place the Radiator fan switch to EMERGENCY
'TRACTION MOTOR BLOWERS' light bright
Check the blower motor fuse
If the motors still do not run
Proceed at ¾ power and fail the locomotive at the first convenient place. Do not run more than 50 miles
Power cannot be obtained when opening the controller
Check the position of the engine maintenance switch
Check the position of the A.W.S. switches
Place A.W.S. switches in their correct positions
The main reservoir pressure has not risen to 70 p.s.i.
Allow more time for the pressure to rise. If it does not
Check if the compressor is running. If it is not
Check the fuse and renew it if necessary
If the compressor still does not run
Turn the exhauster switch to the 'EMERGENCY' position
Check if the vacuum or air pressure switches are isolated
Open the isolating cocks
The vacuum has not risen to 15in. Hg
Allow more time for the vacuum to create
If the vacuum remains at zero
Check that the exhauster switch is in the 'ON' position. If the exhauster still does not run place the switch in the 'EMERGENCY' position
Check the rear cab brake valve
Check the driver's safety device and isolate it if necessary
Power is lost when running
The vacuum falls to 12½in. Hg or less
If the vacuum is partially destroyed
Check for a passenger communication
If the AWS horn is sounding press the 'CANCEL' button. If the horn continues to sound isolate the equipment
Check if the guard has applied the brakes
If the vacuum is fully destroyed
On a fully braked train
Check for faulty hoses and connections
The main reservoir pressure falls to 56 p.s.i. or less
Check if the compressor has stopped. If so
Test the fuse and renew it if necessary
Check for leakage
Check the 'EARTH FAULT' relay in the control cabinet
If this shows 'TRIP' fail the locomotive
DO NOT ATTEMPT TO RESET THE RELAY

ALL DEFECTS MUST BE REPORTED

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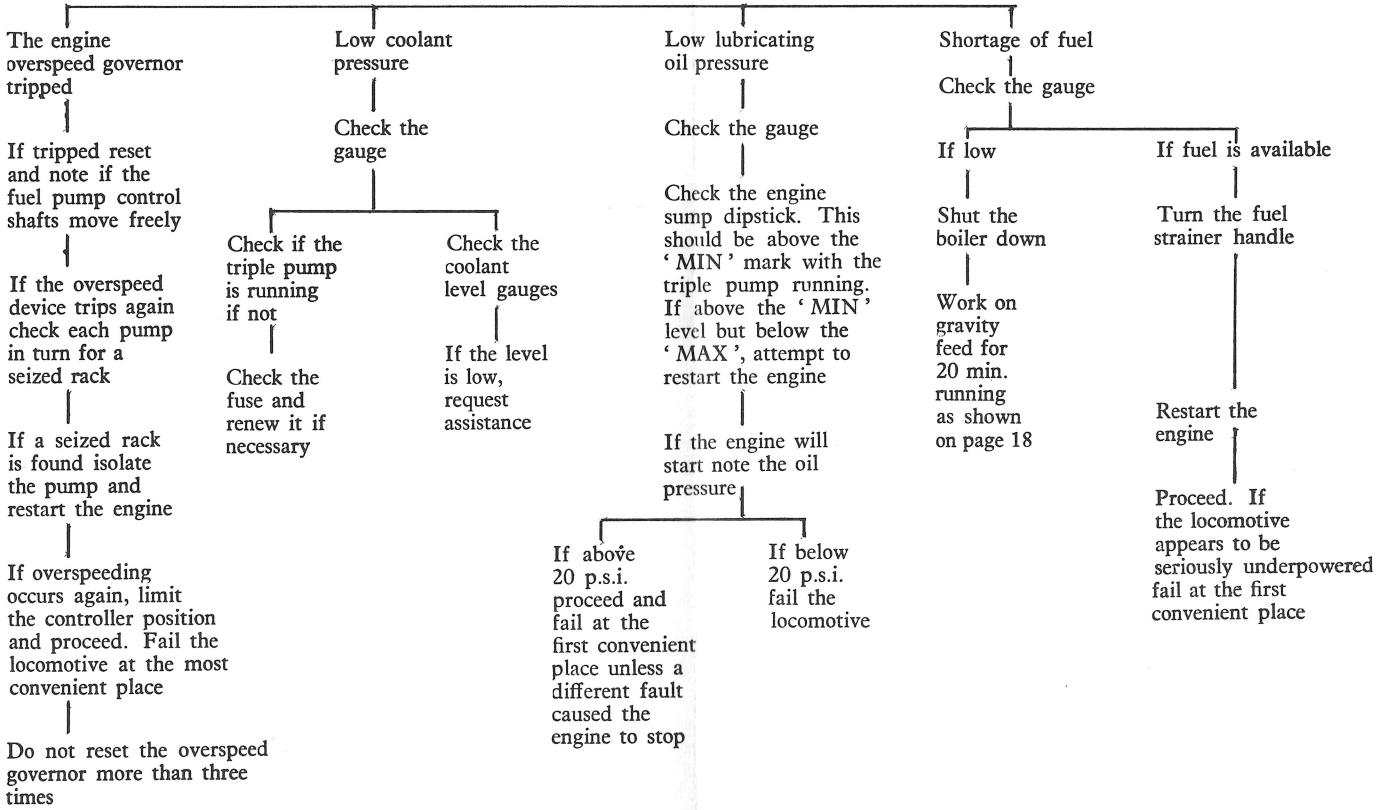
THE RED ENGINE STOPPED LIGHT BECOMES BRIGHT

Stop at the most convenient place before the vacuum is destroyed or air pressure is lost. Carry out any necesary protection rules.

PROBABLE CAUSE

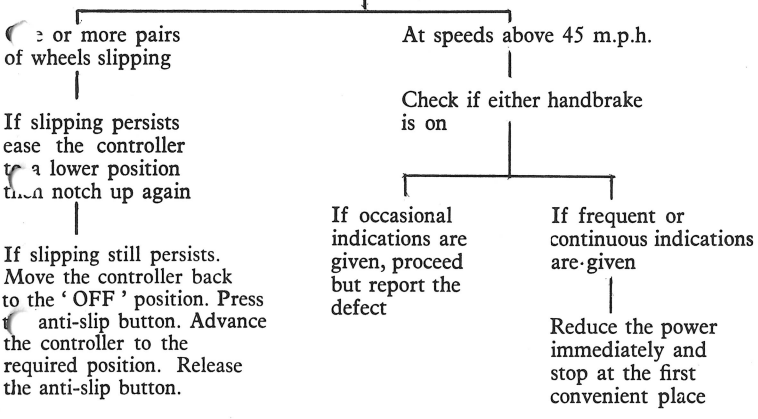

The engine overspeed governor tripped
If tripped reset and note if the fuel pump control shafts move freely
If the overspeed device trips again check each pump in turn for a seized rack
If a seized rack is found isolate the pump and restart the engine
If overspeeding occurs again, limit the controller position and proceed. Fail the locomotive at the most convenient place
Do not reset the overspeed governor more than three times
Low coolant pressure
Check the gauge
Check if the triple pump is running if not
Check the fuse and renew it if necessary
Check the coolant level gauges
If the level is low, request assistance
Low lubricating oil pressure
Check the gauge
Check the engine sump dipstick. This should be above the 'MIN' mark with the triple pump running. If above the 'MIN' level but below the 'MAX', attempt to restart the engine
If the engine will start note the oil pressure
If above 20 p.s.i. proceed and fail at the first convenient place unless a different fault caused the engine to stop
If below 20 p.s.i. fail the locomotive
Shortage of fuel
Check the gauge
If low
Shut the boiler down
Work on gravity feed for 20 min. running as shown on page 18
If fuel is available
Turn the fuel strainer handle
Restart the engine
Proceed. If the locomotive appears to be seriously underpowered fail at the first convenient place

NOTE : If the Diesel engine stops and ALL warning lights become EXTINGUISHED the control circuit breaker should be checked and reset if tripped.

ALL DEFECTS MUST BE REPORTED

THE AMBER WHEEL SLIP LIGHT BECOMES BRIGHT

PROBABLE CAUSE


2 or more pairs of wheels slipping
If slipping persists ease the controller to a lower position then notch up again
If slipping still persists. Move the controller back to the 'OFF' position. Press the anti-slip button. Advance the controller to the required position. Release the anti-slip button.
At speeds above 45 m.p.h.
Check if either handbrake is on
If occasional indications are given, proceed but report the defect
If frequent or continuous indications are given
Reduce the power immediately and stop at the first convenient place

Full details of the locomotive speed and controller position must be reported in all instances of false wheel slip indication.

ALL DEFECTS MUST BE REPORTED

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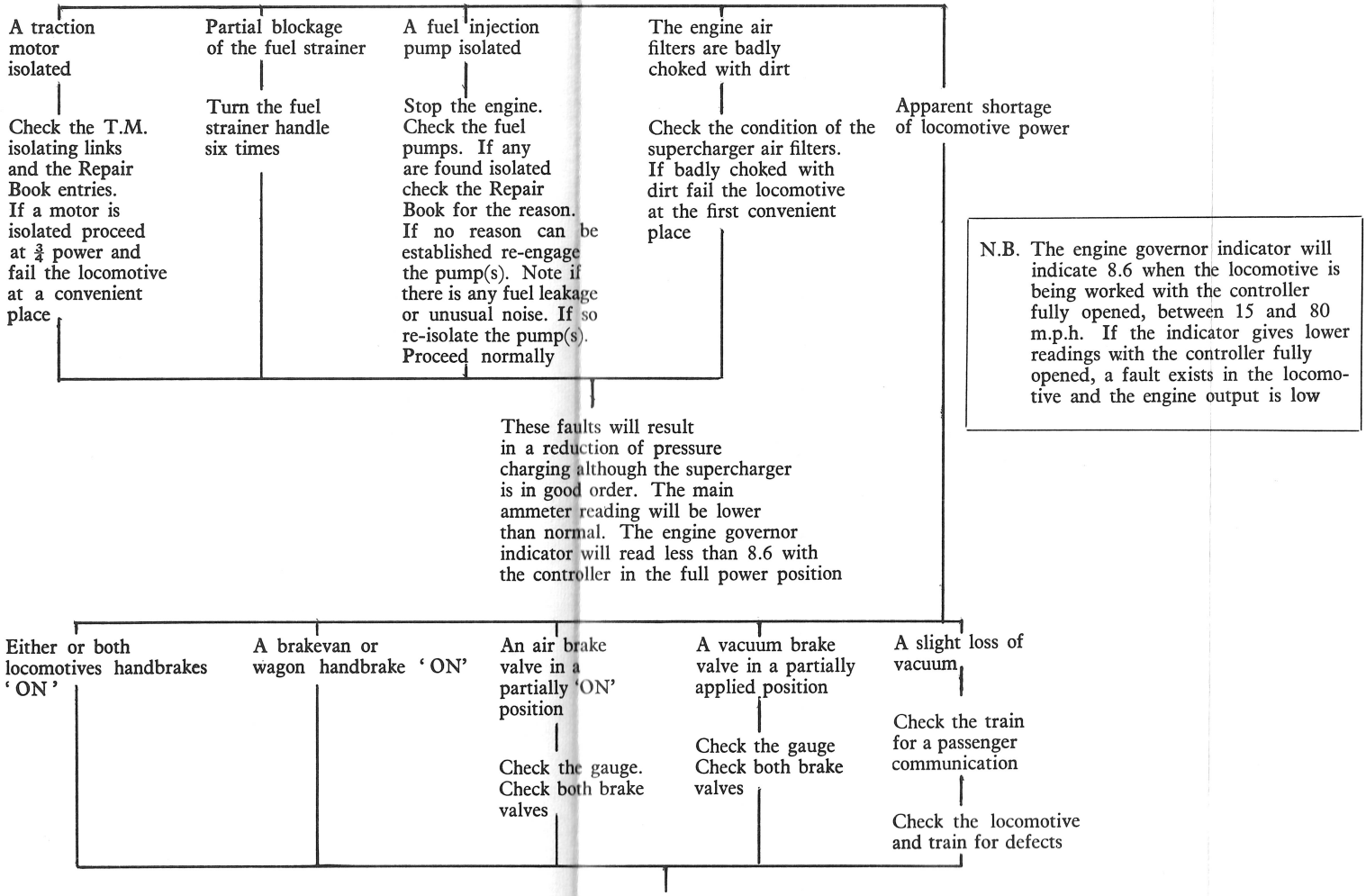
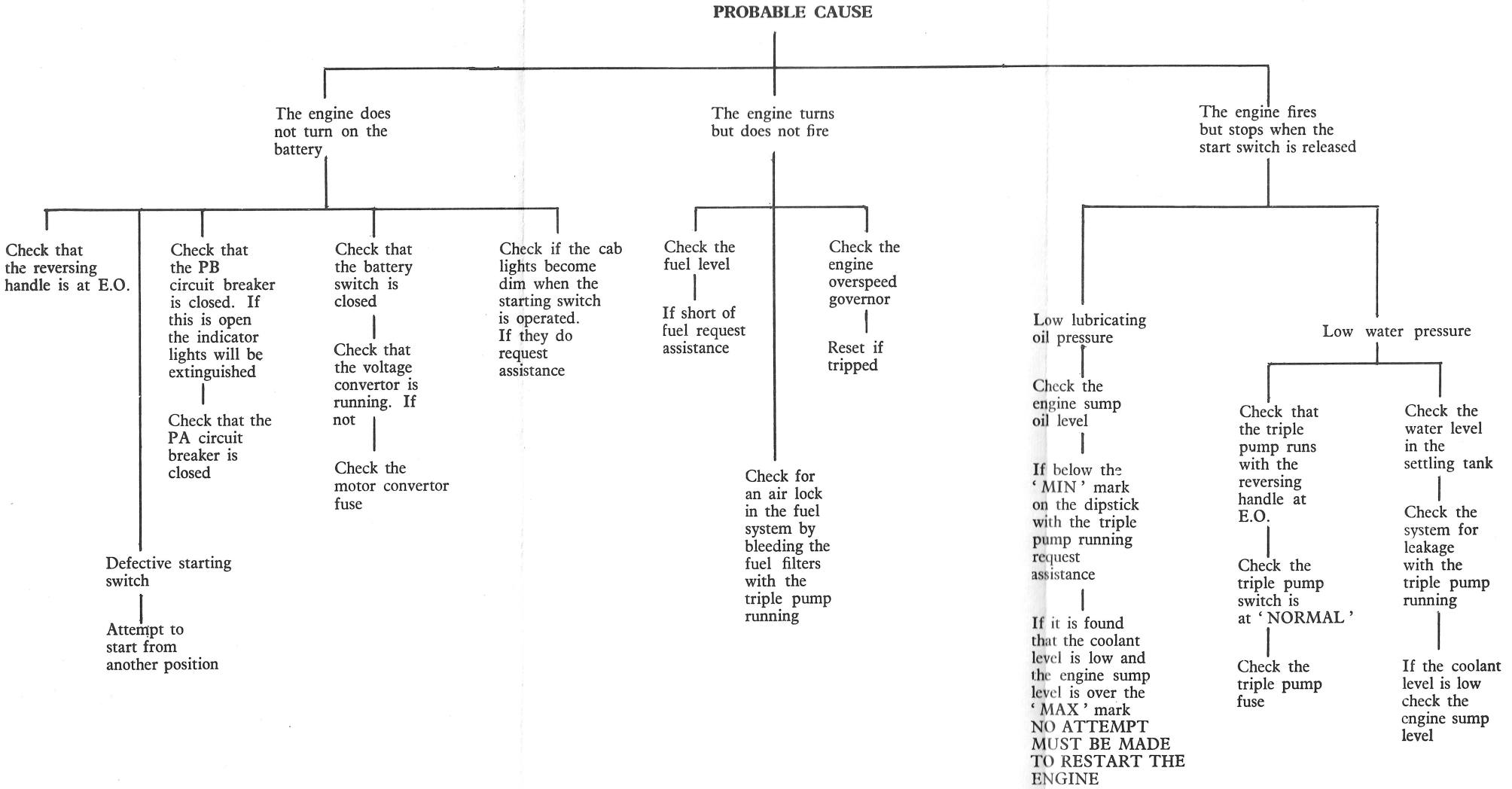
THE LOCOMOTIVE DOES NOT PULL EFFECTIVELY

PROBABLE CAUSE


A traction motor isolated
Check the T.M. isolating links and the Repair Book entries. If a motor is isolated proceed at ¾ power and fail the locomotive at a convenient place
Partial blockage of the fuel strainer
Turn the fuel strainer handle six times
A fuel injection pump isolated
Stop the engine. Check the fuel pumps. If any are found isolated check the Repair Book for the reason. If no reason can be established re-engage the pump(s). Note if there is any fuel leakage or unusual noise. If so re-isolate the pump(s). Proceed normally
The engine air filters are badly choked with dirt
Check the condition of the supercharger air filters. If badly choked with dirt fail the locomotive at the first convenient place
These faults will result in a reduction of pressure charging although the supercharger is in good order. The main ammeter reading will be lower than normal. The engine governor indicator will read less than 8.6 with the controller in the full power position
Apparent shortage of locomotive power
N.B. The engine governor indicator will indicate 8.6 when the locomotive is being worked with the controller fully opened, between 15 and 80 m.p.h. If the indicator gives lower readings with the controller fully opened, a fault exists in the locomotive and the engine output is low
Either or both locomotives handbrakes 'ON'
A brakevan or wagon handbrake 'ON'
An air brake valve in a partially 'ON' position
Check the gauge. Check both brake valves
A vacuum brake valve in a partially applied position
Check the gauge Check both brake valves
A slight loss of vacuum
Check the train for a passenger communication
Check the locomotive and train for defects
Full pressure charging will be obtained in these circumstances

ALL DEFECTS MUST BE REPORTED

THE ENGINE WILL NOT START WHEN THE STARTING SWITCH IS OPERATED


PROBABLE CAUSE
The engine does not turn on the battery
Check that the reversing handle is at E.O.
Defective starting switch
Attempt to start from another position
Check that the PB circuit breaker is closed. If this is open the indicator lights will be extinguished
Check that the PA circuit breaker is closed
Check that the battery switch is closed
Check that the voltage convertor is running. If not
Check the motor convertor fuse
Check if the cab lights become dim when the starting switch is operated. If they do request assistance
The engine turns but does not fire
Check the fuel level
If short of fuel request assistance
Check for an air lock in the fuel system by bleeding the fuel filters with the triple pump running
Check the engine overspeed governor
Reset if tripped
The engine fires but stops when the start switch is released
Low lubricating oil pressure
Check the engine sump oil level
If below the 'MIN' mark on the dipstick with the triple pump running request assistance
If it is found that the coolant level is low and the engine sump level is over the 'MAX' mark NO ATTEMPT MUST BE MADE TO RESTART THE ENGINE
Low water pressure
Check that the triple pump runs with the reversing handle at E.O.
Check the triple pump switch is at 'NORMAL'
Check the triple pump fuse
Check the water level in the settling tank
Check the system for leakage with the triple pump running
If the coolant level is low check the engine sump level

ALL DEFECTS MUST BE REPORTED

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